LLI

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Region 5
Superfund Division
77 West Jackson Boulevard
Chicago, Illinois 60604

DATE : June 6, 2001

SUBJECT: Survey, Lindsay Light Building, 161 East Grand Avenue, Chicago, Illinois on March 24, 27, and 31, 2001

FROM: Larry Jensen, CHP
Senior Health Physicist
Emergency Response Section #3

TO: Verneta Simon
On-Scene Coordinator
Emergency Response Section #3

Fred Micke
On-Scene Coordinator
Emergency Response Section #3

The following is a report on radiological surveillance actions at the Lindsay Light Building, 161 East Grand Avenue, Chicago, Illinois, prompted by private remedial actions in the building, especially with regard to a basement chimney, and by continuing concern expressed by the local community group, Streeterville Organization of Active Residents (SOAR).

The U.S. Environmental Protection Agency (USEPA), working with the City of Chicago Department of Environment, undertook a primary investigation on March 24, 2001, collected additional samples and made limited measurements on March 27, and collected monitors and took additional, limited, measurements, on March 31.

DATA COLLECTION GOALS

USEPA sought data on the following aspects.

- **General radiation state of the building.** A 1993 survey report on radiological surveillance in the Lindsay Light Building by USEPA and the Illinois Department of Nuclear Safety (IDNS) provided gamma-ray exposure rates measured throughout the building. USEPA sought to compare present gamma conditions with those in the past report.

- **Conditions relevant to the chimney.** USEPA had information that remedial actions had been undertaken by building owners in 2000. USEPA sought to assess the changes by observation and measurement.

- **Radon conditions in the building.** Measurements of thoron (radon-220) and radon (radon-222) were made in the building by the Occupational Safety and Health Administration (OSHA) in 1994. USEPA sought to measure thoron and radon conditions again in 2001 to compare data against relevant criteria.

- **Removable contaminants.** Loose radiological materials could be spread further through the building and spread outside. USEPA sought to investigate removable contamination by taking smears and by measuring material adhering to the soles of booties worn in the basement during the surveillance. Qualitative evidence for/against tracking was sought and, where removable surface contamination was found, the identity and level of contamination was to be determined. Comparisons to relevant criteria were intended.

- **Wall interference.** Count rates measured on or near walls can be affected by the natural radioactive materials in bricks, which will add to any contaminant count rates. USEPA sought to make measurements on walls to assess the impact of this interference.

SURVEILLANCE APPROACHES

Gamma count rate—In most cases, when a radioactive decay occurs, a gamma ray is produced. Hand held meters can detect these. Each gamma ray registered is a count. The more radioactive material in an area or the stronger the radioactive material, the higher the count rate.

USEPA staff, using count rate meters, measured gamma ray levels throughout the basement and five floors of the building. A background level was measured and other quantitative readings were made throughout.

Instruments used were a two by two sodium iodide detector and a FIDLER sodium iodide detector. The two by two was a thick cylinder of sodium iodide that detected gamma rays of all energies. The FIDLER was a wide, thin disk of sodium iodide that detects only low energy gamma rays. Both instruments express the gamma count rate in counts per minute.

Gamma ray exposure and dose—The level and degree of radiation hazard can be measured by gamma ray exposure rate or by dose rate. These can be used to compute risk.

Primarily based upon elevated count rates seen in critical areas, such as those where employees spent many hours, measurements of the gamma exposure rate or dose rate were made.

These measurements, in unison with exposure times, allow for the calculation of accumulated dose and/or risk.

Exposure rates were measured with a micro-R meter (in microroentgen per hour, mR/hr) while dose rates were measured with a micro rem meter (in microrem per hour, urem/hr).

Radon and thoron gas concentration—Certain radioactive materials, like uranium and thorium, produce radioactive gases. Thus, solid radioactive materials can have a more widespread impact because they produce gases that diffuse throughout rooms, floors and the building.

In areas of elevated count rate or where critical information on conditions was needed, measurements of the radon (radon-222) and thoron (radon-220) gas levels were made. Radon is produced from radioactive decay in the Uranium Decay Series and thoron is produced from radioactive decay in the Thorium Decay Series. Both, from radioactive decays of the gases, produce charged, solid elements called decay products or daughters which are responsible for most of the inhalation hazard.

Radon and thoron gas concentrations (in picocuries per liter, pCi/L) were measured by a pair of electret devices. Electrets, or e-perms, have an electrostatically charged disk whose voltage is reduced when charged decay products collide with its surface. One e-perm effectively measures radon plus thoron while the other measures thoron only. A pair of e-perms, left out for a week, can measure both average radon and average thoron gas concentrations using the initial and final voltages of the charged disk. The average gamma exposure rate must be measured to make a small correction.

Radon and thoron decay product concentrations—Radon and thoron gases each produce decay products. These are alpha particle emitting radionuclides that are potent inhalation hazards. Most of the hazard from radon and thoron gases comes from the decay products, not the gases.

Decay product concentrations are not as readily measured as are the gas concentrations. Therefore, using characteristic parameters and data known from research, decay product concentrations (in working levels, WL) can be calculated from gas concentrations.

Removable contamination—Radioactive material that is not fixed or bonded to a surface or to an object can stick to shoes when it is walked on, stick to clothing or belongings when it is brushed against, be ingested when it gets on hands, food, cigarettes, etc. It can be swept up. These radioactive materials could be spread further throughout the building and even out of the building, increasing the scope of the problem in area and in degree.

Removable contamination was assessed in three ways. First, by rubbing a small paper disk (a smear) across the floor, loose dirt was collected. Measurements were made on the smear for gross alpha particle concentrations, gross beta particle concentrations and radionuclide identity. Second, by wearing shoe covers (booties) while working in the basement and then measuring their gross alpha particle levels. Third, by collecting particulate materials from in and near the remaining chimney structure and measuring its radionuclide concentration and identity.

To be more specific, removable contamination was assessed by smearing about a meter (100 square centimeters, cm^2) of floor with small disks of paper. Laboratory count rate meters were used to measure the gross beta particle and gross alpha particle concentrations in disintegrations per minute per smear. From the material on these smears, the radionuclide identities were determined using gamma spectrometry.

In addition, shoe covers (booties) were worn while working in the basement. Loose material stuck onto the sole of the bootie. After a day's wait to allow for any obscuring, short lived, radionuclides to decay away, gross alpha particle concentrations (in counts per minute, cpm) were made with an alpha scintillometer to determine if long-lived radionuclides (such as thorium and uranium radionuclides) were present. Identity of these adhering radionuclides can be inferred from the radionuclide identity analysis performed on the smears.

Finally, loose material on the walls and base of the remaining chimney and from the floor below was collected. This material was analyzed for radionuclide identity and concentration (in picocuries per gram, pCi/g) by gamma spectrometry.

Wall interferences—Bricks contain naturally occurring radioactive materials (NORM), including Uranium Decay Series radionuclides and Thorium Decay Series radionuclides, that can obscure contamination measurements. NORM in bricks is not considered a contaminant.

To assess the degree to which NORM was contributing to elevated gamma measurements in the chimney area, gamma count rates (in counts per minute) were made, horizontally along the wall, at increasing distances from the chimney. Measurements were also made on a wall far removed from the chimney.

The FIDLER was used to make these measurements.

COMPARISON CRITERIA

The following criteria are based upon conferring with USEPA's Office of Solid Waste and Emergency Response (OSWER) in Headquarters on the numerous criteria that might be applied to this survey data. The Region and OSWER feel the following are most appropriate.

Gamma count rate—The background gamma count rate (in counts per minute, cpm) was measured in the building's basement. Other measurements were taken throughout the building so that relative comparisons of gamma count rate could be made to background. There is not a regulatory standard or criteria specifically for gamma count rate. These measurements are largely a pragmatic way of identifying where to focus for more specific measurements, such as dose rate, based upon deviations from background levels.

Gamma dose rate–Gamma dose rates were measured throughout the building (in microrem per hour, urem/hr). The background dose rate was measured in the basement kitchen. The net dose rate (measured dose rate less the background dose rate) is the excess dose rate at the measurement location. This value can be used to compute excess dose or excess risk to an individual exposed at that location.

USEPA, based upon directives issued by OSWER, focused upon risk rather than dose due to fundamental authorities derived from the National Oil and Hazardous Substances Pollution Contingency Plan (National Contingency Plan, NCP), where risk is the designated judgment parameter. OSWER Directive No. 9200.4-18, Establishment of Cleanup Levels for CERCLA Sites and Radioactive Contamination, also sets risk as the appropriate parameter for judgment.

Excess risk can be calculated by:

(net gamma dose rate) x (hours of exposure) x (years of exposure) x (risk coefficient)

Hours and years of exposure are specific to individuals and/or locations in this building. The latest cancer incidence risk coefficient provided by USEPA Headquarters is 8.46 x 10^{-7} per millirem. This coefficient expresses the risk (8.46 x $10^{-7)}$ for cancer incidence (not fatality) caused when 1 millirem of dose is received. It can be found in the USEPA document, "Cancer Risk Coefficients for Environmental Exposure to Radionuclides, Federal Guidance Report No. 13" (1999) The NCP constrains the excess upper bound lifetime cancer risk range for an individual to 10^{-6} to 10^{-4}, with 1 x 10^{-6} taken as the point of departure for determining remediation goals and 1 x 10^{-4} is generally taken as the upper limit. Point of departure refers to the starting point above which greater risks need justification.

Gamma exposure rate–A limited number of gamma exposure rate measurements were made during this survey. The gamma exposure rate can be taken as numerically equal to the gamma dose rate when only gamma radiation is involved. Thus, the net gamma exposure rate can be calculated as the gamma exposure rate at the measured location minus the background gamma dose rate. Excess risk would be calculated the same way as for gamma dose rate and compared to the same NCP risk range.

Gamma dose to embryo/fetus—The fetus is believed to be more radiation sensitive than an adult mother, especially at critical growth periods. However, there are no modified radiation risk coefficients for a fetus. Therefore, the risk to a fetus can be computed from gamma dose rate or gamma exposure rate in the same way as for an adult and compared to the same NCP risk range. However, the intent should be to keep the risks as low as reasonably achievable for a fetus, closer to 10^{-6}.

Radon and thoron gas concentrations—Radon and thoron gas concentrations were measured and can be compared to the indoor radon decay product standards in USEPA's Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings in Title 40, Part 192 of the Code of Federal Regulations (40 CFR 192).

This standard is 0.02 working levels for radon-222 decay products. Radon decay products are the solid, electrically charged elements produced by radioactive decay of radon gas.

Moreover, USEPA Headquarters interpreted 40 CFR 192 to read that, when radon-220 is the radon of concern, the same numerical standard, 0.02 WL, applies.

When both radon-222 and radon-220 are of concern, the sum of two fractions must be less than 1.0. This is called the Rule of Ratios. One fraction is the measured radon-222 decay product concentration divided by the radon-222 decay product standard (0.02 working levels, WL). The second fraction is the measured radon-220 decay product concentration divided by the radon-220 decay product standard (0.02 WL).

After conferring with USEPA Headquarters, they advised our Regional office to use the same radon standard for this commercial building as is used for a residence.

Finally, to conform to these interpretations, radon levels for the Lindsay Light Building, measured in radon gas units (because of instrument constraints) need to be converted to radon decay product units. This requires (1) an equilibrium relationship between radon gases and radon decay products and (2) an equilibrium factor for radon decay products.

Publication 32 by the International Commission on Radiological Protection (Limits for Inhalation of Radon Daughters by Workers) provided parameters for (1), namely

- Radon-222: 100 picocuries per liter (pCi/L) for 1 WL, at equilibrium
  Radon-220: 7.43 pCi/L for 1 WL, at equilibrium

For item (2), Headquarters recommended 40% for radon-222 in a building. With limited data for radon-220, the research of Dr. Stephen D. Schery published in Chapter 10 (Thoron and Its Progeny in the Atmospheric Environment) of the book Gaseous Pollutants: Characterization and Cycling was relied upon. The radon-220 equilibrium fraction in a building was taken to be 3%.

Loose Material—USEPA Region 5 has set a cleanup criterion for soil at other Lindsay related sites in the Streeterville area. This level is an activity concentration for total radium (radium-226 + radium-228) of 7.1 pCi/g, including background. This level should be used to assess material found on the floor of the building.

Wall Interferences—Background count rates for the wall bricks can be taken as the lowest count rates measured on the wall. Chimney count rates can be compared to these. There are no criteria for this measurement. This is simply a pragmatic method to investigate the effects of the wall.

SUMMARY OF CRITERIA

Gamma count rates—compare to building background

Gamma-ray dose rates and exposure rates–convert to risk and compare to 1×10^{-6} to 1×10^{-4}

Gamma-ray dose rates and exposure rates for fetus–convert to risk and compare to 1×10^{-6} to 1×10^{-4} with goal of 1×10^{-6}

Radon-222 concentration–convert to decay product concentration and compare to 0.02 WL

Radon-220 concentration–convert to decay product concentration and compare to 0.02 WL

Radon-222 and radon-220 combined–convert to decay product concentrations and determine if the following Rule of Ratios equation is satisfied

(radon-222 decay product concentration / 0.02) + (radon-220 decay product concentration / 0.02) < 1.0

Loose contamination—7.1 pCi/g total radium (Ra-226 + Ra-228) including background

Wall interferences—Lowest measured count rate, as distant from chimney as possible, can be taken as the natural level of the wall bricks.

DATA SUMMARIES

Gamma Count Rates

Background was measured in the basement lunchroom (7000 counts per minute, cpm). Ranges for count rates (including background) by floor were:

- **Basement** 7000 - 150,000 cpm
- **1st Floor** 95,000 - 200,000 cpm
- **2nd Floor** 9000 - 800,000 cpm
- **3rd Floor** 12,000 - 152,000 cpm
- **4th Floor** 15,000 - 460,000 cpm
- **5th Floor** 17,000 cpm

See Appendix 1 and Appendix 2 for complete data by location and instrument.

These data should be viewed relatively, comparing to background levels.

Gamma Doses and Risks

Gamma dose rates and occupancy times are required to compute both dose and risk. Times are not available presently.

Background dose rate was measured in the basement lunchroom (7 microrem per hour, urem/hr). Ranges for dose rate (including background) by floor were:

- **Basement** 13 - 30 urem/hr
- **1st Floor** 30 - 50 urem/hr
- **2nd Floor** 20 - 130 urem/hr
- **3rd Floor** 90 urem/hr
- **4th Floor** 13 urem/hr
- **5th Floor** 13 urem/hr

See Appendix 3 for complete data by location.

These measurements were made with a micro rem meter. In the 1993 survey by USEPA and the Illinois Department of Nuclear Safety (IDNS) micro-R meters were used. While these different meters are intended to provide comparable dose rate readings, in reality, because of the different meter systems the results are not identical. For this survey, USEPA had to rely largely on the micro rem meter because, on March

24, it was the only meter available. When a micro-R meter became available on March 31, it was used in only a few limited places because of the terms of the access agreement. Where the micro-R meter readings were obtained, the range of results were:

- **2nd Floor**—2.5 - 90 uR/hr

See Appendix 4 for complete data by location.

Also, in 1993, thermoluminescent dosimeters (TLD) were used in critical locations to assess dose. These are commercial devices commonly used for measuring occupational dose. They can be used to measure average dose rate over an extended period of time (month or quarter) so that annual doses can be projected. They would be superior to meters for the Lindsay Light Building conditions. Because of time constraints, it was not possible to use TLDs in this survey.

Radon Concentrations

Because radon is a gas that easily spreads throughout rooms, floors and buildings, it was not easy to select a background location. Where a background was required, the lowest measured radon concentration for all monitoring sites was used. Not all criteria require background subtraction, however, so the unadjusted radon concentration would be used in those situations. Ranges for all measurement sites, including background, were:

- 0.0 - 1.3 pCi/L

See Appendix 5 for complete data by location.

E-Perms were used to measure radon concentrations.

Thoron Concentrations

Thoron gas is produced by thorium related radionuclides as radon is produced by uranium related radionuclides. Background can be set, when necessary, as with radon, using the lowest measured concentration. Ranges for all measurement sites, including background, were:

- 0.6 - 89.3 pCi/L

See Appendix 5 for complete data by location.

Thoron was measured as radon was. This involved a pair of monitors, where the readings from both allow the calculation of the separate radon and thoron concentrations.

Radon Decay Product Concentrations

Because the dominant health hazard of radon arises, not from the gas, but from the alpha particle emitting decay products produced by radon gas, radon decay product criteria are appropriate. Calculated ranges for all measurements, based upon gas concentrations, were:

- 0.0 - 0.005 WL

See Appendix 5 for complete data by location.

Radon gas concentrations were translated to equivalent radon decay product concentrations using standard USEPA parameters (100 pCi/L per working level and 40% equilibrium).

Thoron Decay Product Concentrations

As with radon, thoron decay products are the dominant source of health hazard. Ranges for all measurements, calculated from gas concentrations, were:

- 0.002 - 0.361 WL

See Appendix 5 for complete data by location.

Thoron gas concentrations were translated to equivalent thoron decay product concentrations using parameters found in ICRP 32 and in a chapter in the book Gaseous Pollutants: Characterization and Cycling written by S.D. Schery and D.M. Grumm (7.43 pCi/L per working level and 3% equilibrium, respectively).

Combined Radon and Thoron Decay Product Concentrations

USEPA criteria for combined radon and thoron decay products are based on the Rule of Ratios, where application of the rule results in a level greater than 1 when the combined decay product concentrations exceed the criteria. Ratios ranged from:

- 0.2 - 18

See Appendix 5 for complete data by location.

Removable Contamination Levels - Smears

Smears were taken along a line extending away from the chimney to determine if *removable radioactivity was present and, if so, what was its identity by radionuclide.* Removable radioactivity was assessed by gross alpha and gross beta concentrations. Gross alpha is the sum of all alpha emissions measured while gross beta is the sum of all beta emissions measured. The range of measurements were:

Gross Alpha

- 34 - 76 disintegrations per minute, dpm/smear

Gross Beta

- 17 - 41 dpm/smear

See Appendix 6 for complete data.

These smears were analyzed by USEPA's National Air and Radiation Environmental Laboratory (NAREL) using their Tennelec brand counting equipment.

Removable Contamination Identity - Smears

The smears were also analyzed for radionuclide identity. Smears showed :

- Potassium-40, K-40
- Lead-212, Pb-212
- Radium-224, Ra-224
- Radium-228, Ra-228
- Thallium-208, Tl-208

Potassium-40 is a natural radionuclide and should not be viewed as a contaminant. The remaining radionuclides are from the Thorium Decay Series. No Uranium Decay Series radionuclides were identified in the analyses.

See Appendix 7 for complete data.

These data were analyzed at NAREL by gamma spectroscopy.

Removable Contamination - Booties

Booties were worn by two USEPA staff while collecting radon monitors and making measurements in the basement on March 31. The two pairs of booties were analyzed

23 hours later to see if long lived radionuclides remained. Long lived radionuclides could include those of the Thorium Decay Series (as well as Potassium-40 and radionuclides of the Uranium Decay Series). The results were

- Lindsay booties   3.8 - 10.8 cpm

See Appendix 8 for complete data.

Removable Contamination - Floor Debris

Loose, gritty, material was collected from the area below, at the base of and within the open chimney area in the basement. This material may have originated from the chimney. It was analyzed for its identity and its activity concentration.

Radionuclide Identities

- **Thorium Decay Series**
  - Radium-228, Ra-228
  - Thorium-228, Th-228
  - Radium-224, Ra-224
  - Radon-220, Rn-220
  - Lead-212, Pb-212
  - Thallium-208, Tl-208

- **Uranium Decay Series**
  - Thorium-234, Th-234
  - Protactinium-234m, Pa-234m
  - Radium-226, Ra-226
  - Lead-214, Pb-214

- **Others**
  - Potassium-40, K-40
  - Thallium-201, Tl-201 **

** Although identified in the spectral report, thallium-201 was not substantiated by related gamma energy peaks. It is believed this peak is due to thorium-228 which has a very close energy in the gamma-ray spectrum.

See Appendix 12 for complete data

Potassium-40 should not be viewed as a contaminant since it is naturally occurring.

This material was analyzed at NAREL by gamma spectroscopy for its activity concentration as well. The results follow below:

Radionuclide Concentrations

Data below is listed as First Measurement/Duplicate Measurement. ND designates not detected.

Thorium Decay Series

• Radium-228, Ra-228	90.5/84.3 pCi/g
• Thorium-228, Th-228	101/84.4
• Radium-224, Ra-224	105/93.7
• Radon-220, Rn-220	211/90.8
• Lead-212, Pb-212	97.6/90.9
• Bismuth-212, Bi-212	87.4/82.2
• Thallium-208, Tl-208	30.2/27.5

Uranium Decay Series

• Thorium-234, Th-234	11.0/7.87 pCi/g
• Protactinium-234m, Pa-234m	ND/8.07
• Radium-226, Ra-226	ND/ND
• Lead-214, Pb-214	0.835/0.953

See Appendix 7 for complete data.

Wall interferences—*Count rates measured horizontally along the wall ranged from*

- 23,228 - 31,997 counts per minute

and counts on the wall away from the chimney ranged from

- 15,475 - 15,888 counts per minute

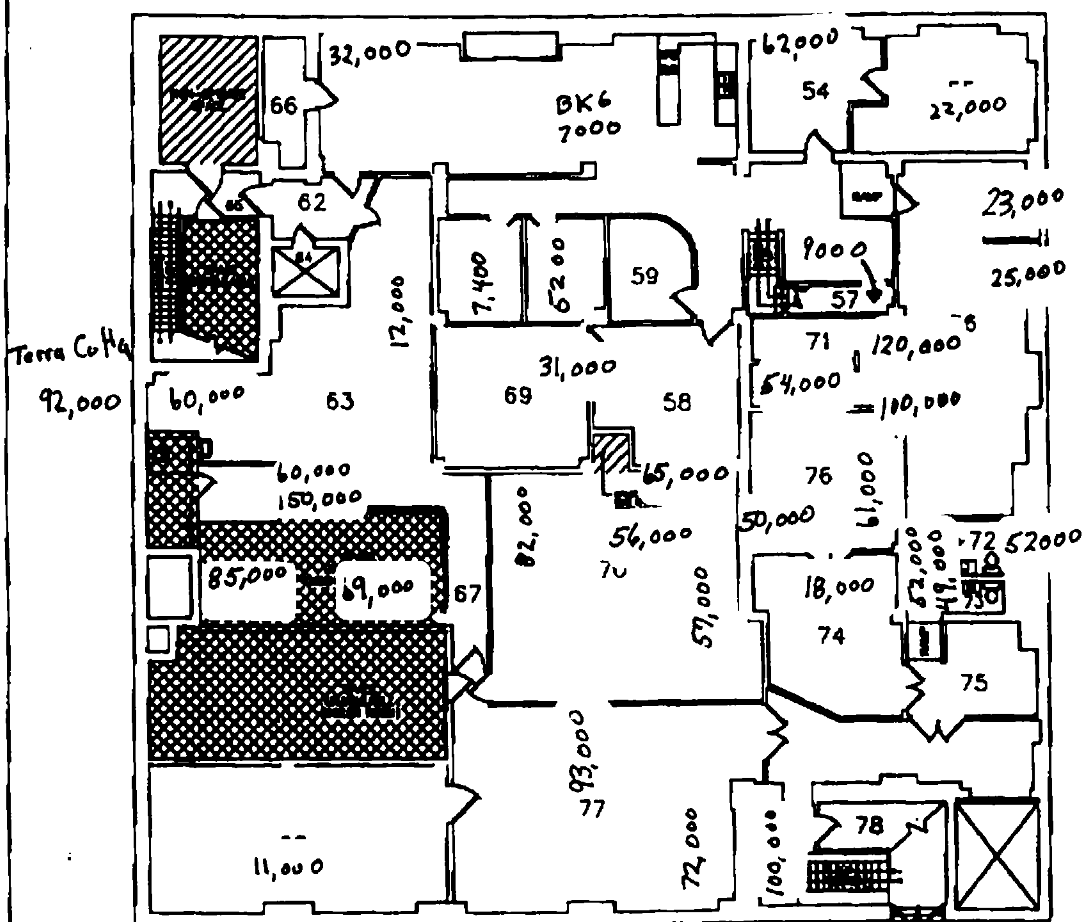
See Appendix 8 for complete data.

Appendix 1

FIDLER MEASUREMENTS BY FLOOR

FIDLER Measurements
(counts per minute, cpm)
(on contact)
3/24/01 data

A1-2

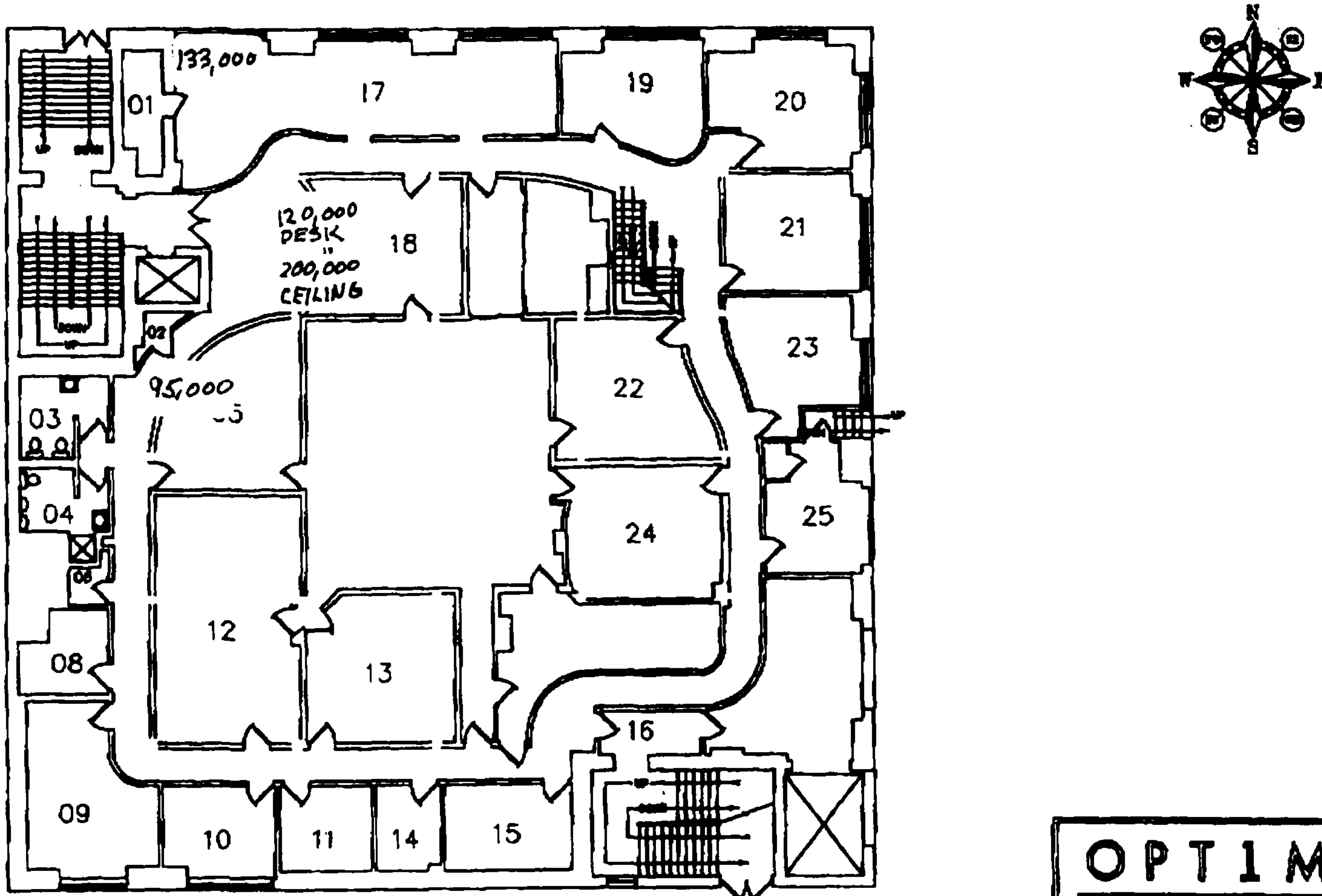


BASEMENT FLOOR PLAN
OPTIMUS
161 EAST GRAND AVENUE
CHICAGO, IL 60611

OPT1MUS
161 E. GRAND AVE., CHICAGO, IL 60611
PHONE: 312-321-0880 FAX: 312-321-9765

FIDLER Measurements
(counts per minute, cpm)
(on contact

3/24/01 data



1st FLOOR PLAN

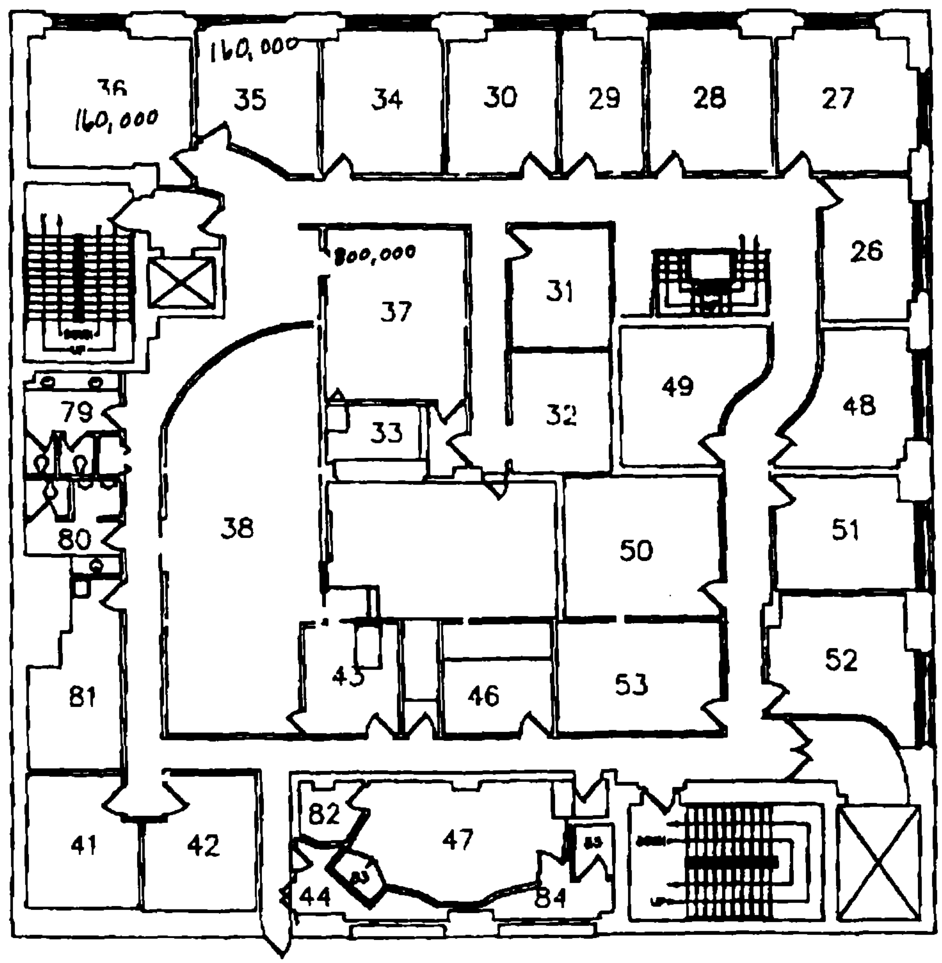
OPTIMUS
161 EAST GRAND AVENUE
CHICAGO, IL. 60611

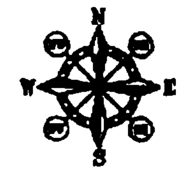
OPTIMUS
161 E. GRAND AVE., CHICAGO, IL 60611
PHONE: 312-321-0880 FAX: 312-321-9785

A1-3

FIDLER Measurements
(counts per minute, cpm)
(on contact)

3/24/01 data





2nd FLOOR PLAN

OPTIMUS
161 EAST GRAND AVENUE
CHICAGO, IL. 60611

A1-4

OPT1MUS

161 E. GRAND AVE., CHICAGO, IL 60611
PHONE: 312-321-0880 FAX: 312-321-9785

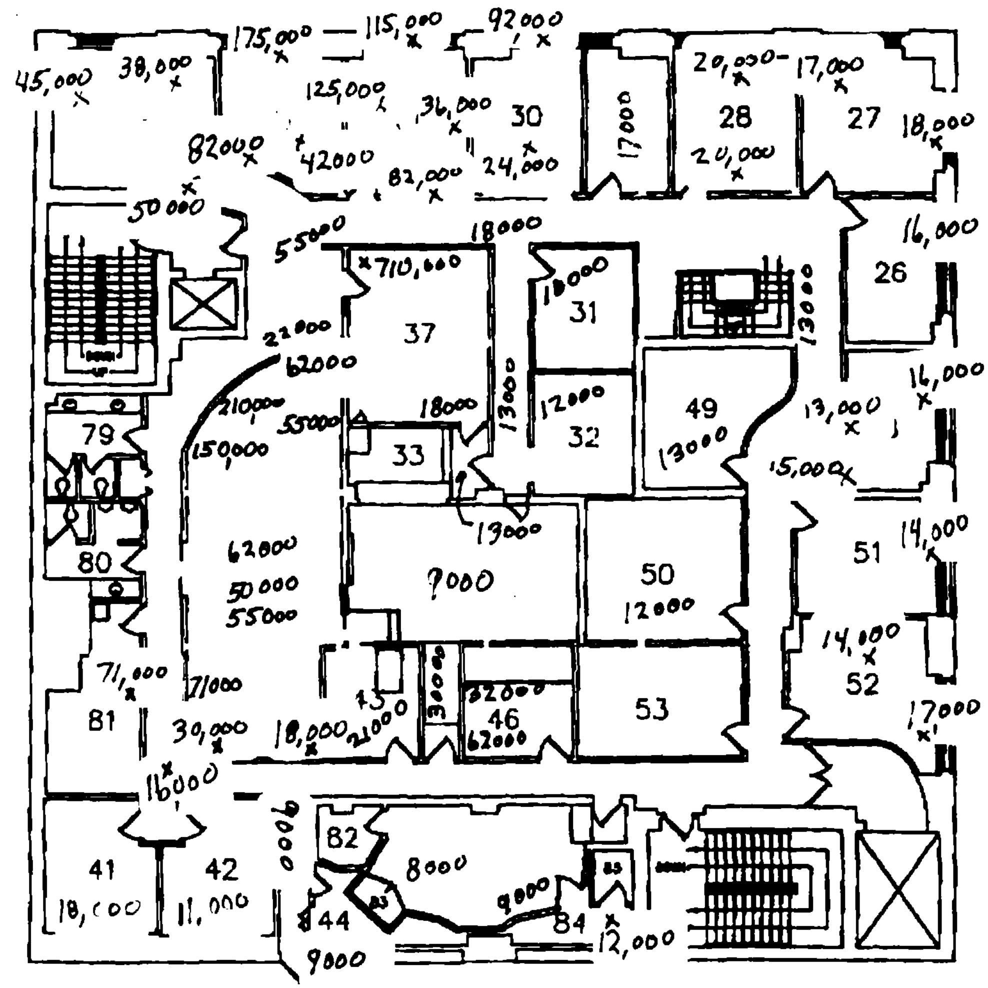
DATE: UNKNOWN	DESCRIPTION:
REV. DATE:	
CAD FILE NAME:	
DRAWN BY:	
CHECKED BY:	DRAWING #: PAGE

Appendix 2

SODIUM IODIDE 2 X 2 MEASUREMENTS

Sodium Iodide 2x2
(Counts per minute, cpm)
(on contact)

3/24/01 data



2nd FLOOR PLAN

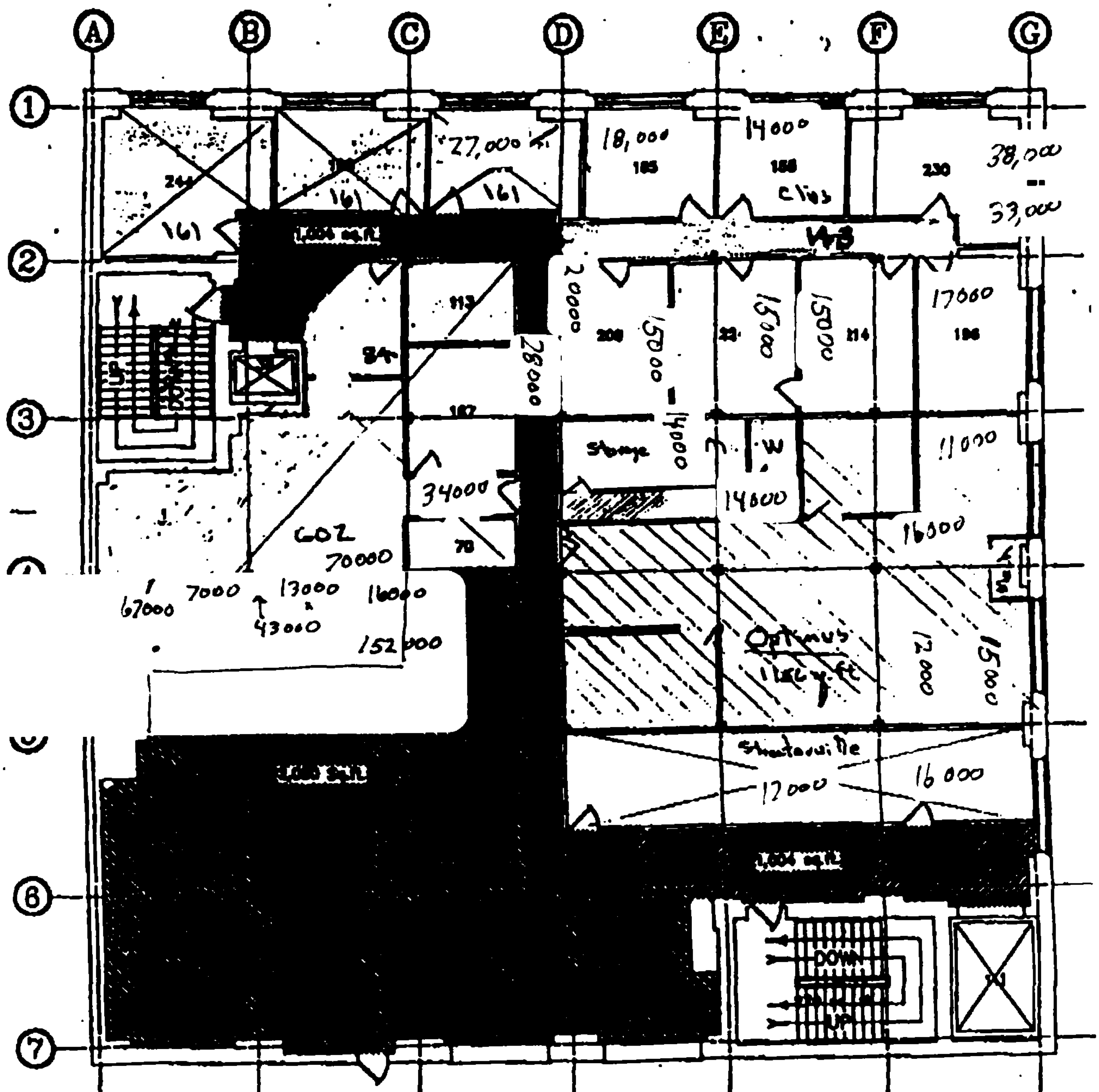
OPTIMUS
161 EAST GRAND AVENUE
CHICAGO, IL. 60611

OPT1MUS
161 E. GRAND AVE., CHICAGO, IL 60611
PHONE: 312-321-0880 FAX: 312-321-9785

A2-2

Sodium Iodide 2x2
Measurements
(counts per minute, cpm)
(on contact)

3/24/01 date

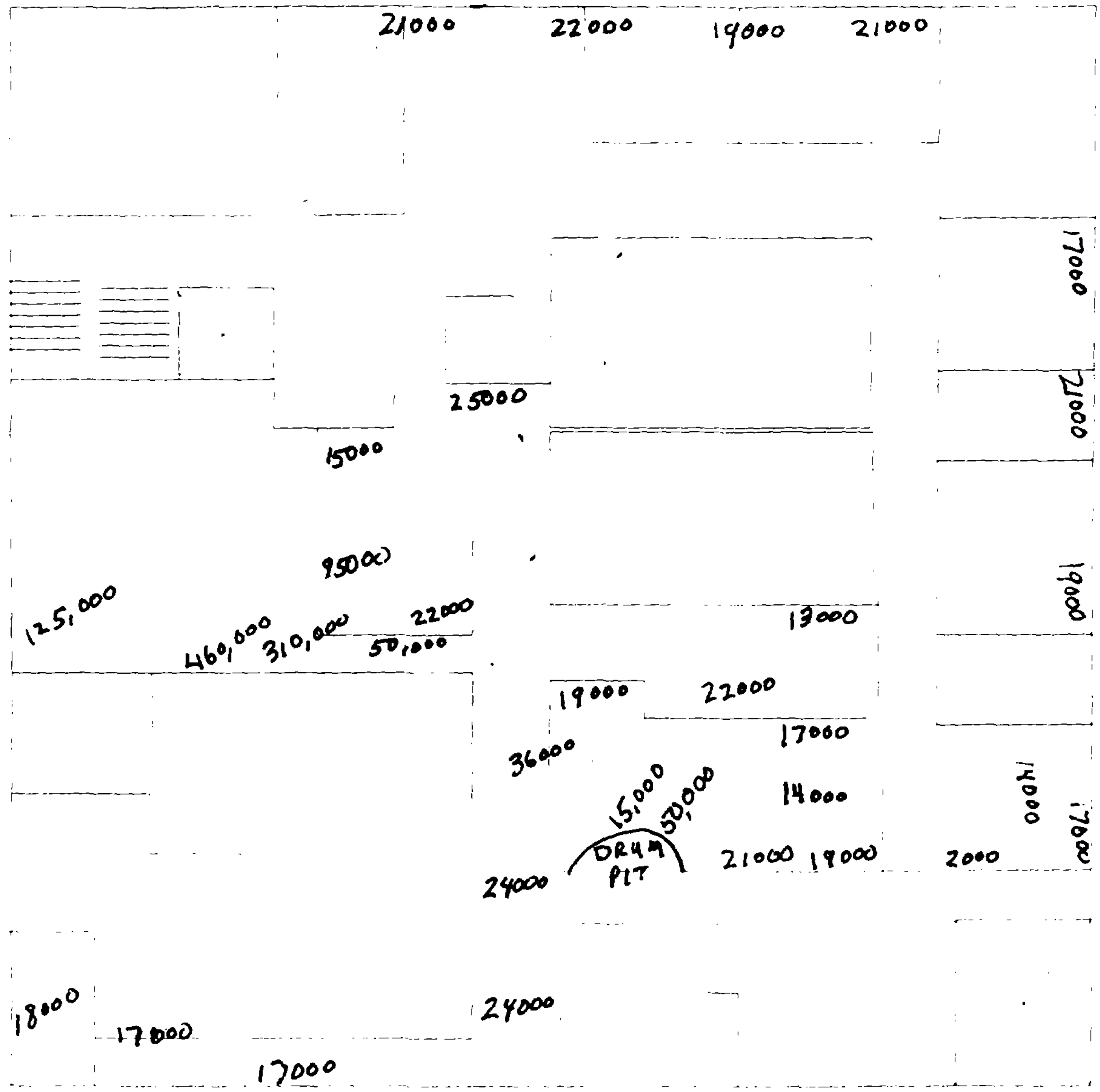


3rd Floor - 161 E. Grand Building

SCALE 1/16" = 1'-0"

Sodium Iodide 2x2
Measurements
(counts per minute, cpm)
(on contact)

3/24/01 data



[redacted]

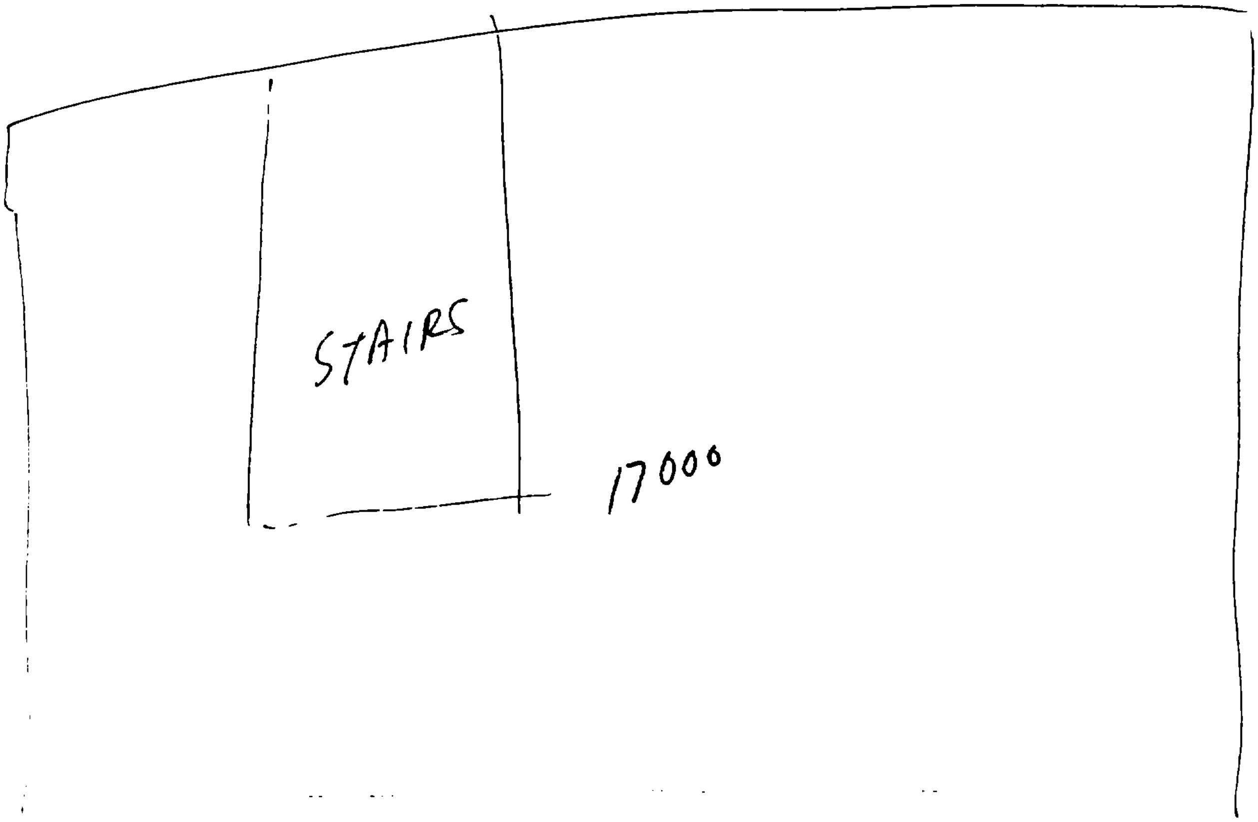
LEGEND

ecology and environment, inc.
Technical Assistance Team
Region V

TITLE 161 E. Grand Ave. 4th Floor (Streeterville)	FIGURE # Figure 4
SITE Lindsay Light Company	TDD# T05-9305-014
CITY Chicago STATE IL	SCALE Not to Scale
SOURCE Instrument: Ludium Model 19	DATE July 15, 1993 REVISED

Sodium Iodide 2x2
Measurements
(counts per minute, cpm)
(on contact)

3/24/01 data



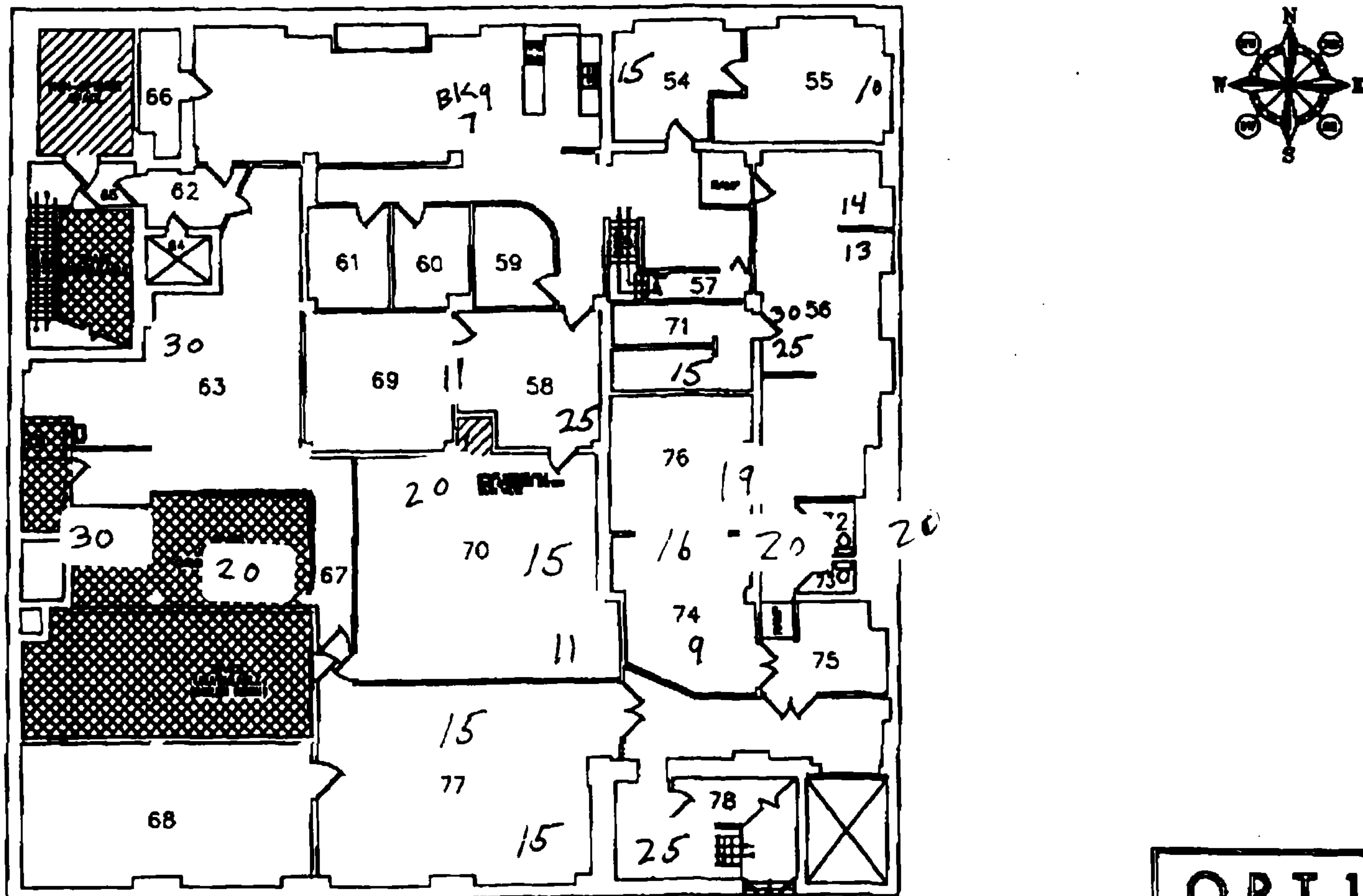
5TH Floor

Appendix 3

MICRO REM METER MEASUREMENTS

Bicron micro rem meter
(micro rem per hour, µrem/hr)
(1 meter off floor

3/24/01 data



BASEMENT FLOOR PLAN
OPTIMUS
161 EAST GRAND AVENUE
CHICAGO, IL 60611

OPT1MUS
161 E. GRAND AVE., CHICAGO, IL 60611
PHONE: 312-321-0880 FAX: 312-321-9765

A3-2

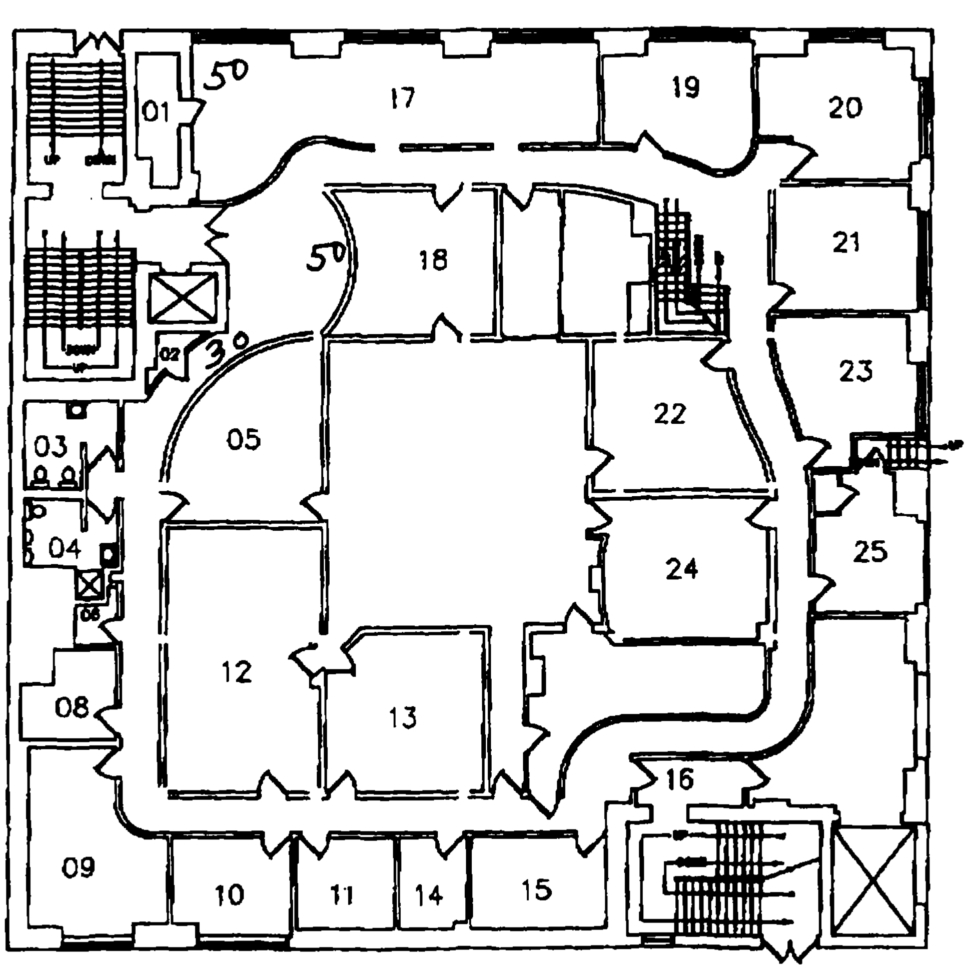
MAR-19-2001 00:51

P.13

Bicron micro rem meter
(microrem per hour, µrem/hr)
(1 meter off floor)

3/24/01 data

A3-4 3



1st FLOOR PLAN

OPTIMUS
161 EAST GRAND AVENUE
CHICAGO, IL. 60611

OPTIMUS

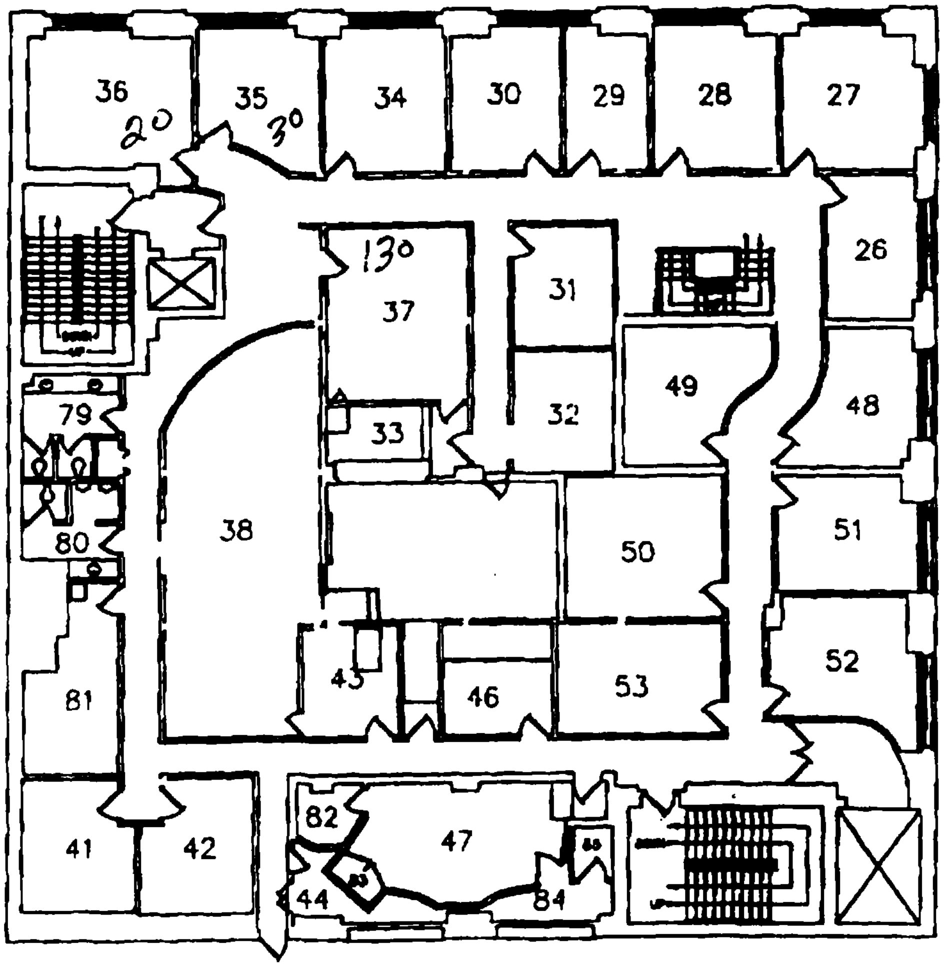
161 E. GRAND AVE., CHICAGO, IL 60611
PHONE: 312-321-0880 FAX: 312-321-8785

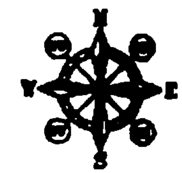
DATE: 08/00/00
REV. DATE:
CAD FILE NAME: 1FLRPLN
DRAWN BY:
CHECKED BY:
APPROVED:
DESCRIPTION:
DRAWING #
PAGE

A3-34

Bicron micro rem meter
(micro rem per hour, μrem/hr)
(1 meter of floor)

3/24/01 data





2nd FLOOR PLAN

OPTIMUS
161 EAST GRAND AVENUE
CHICAGO, IL. 60611

OPT1MUS

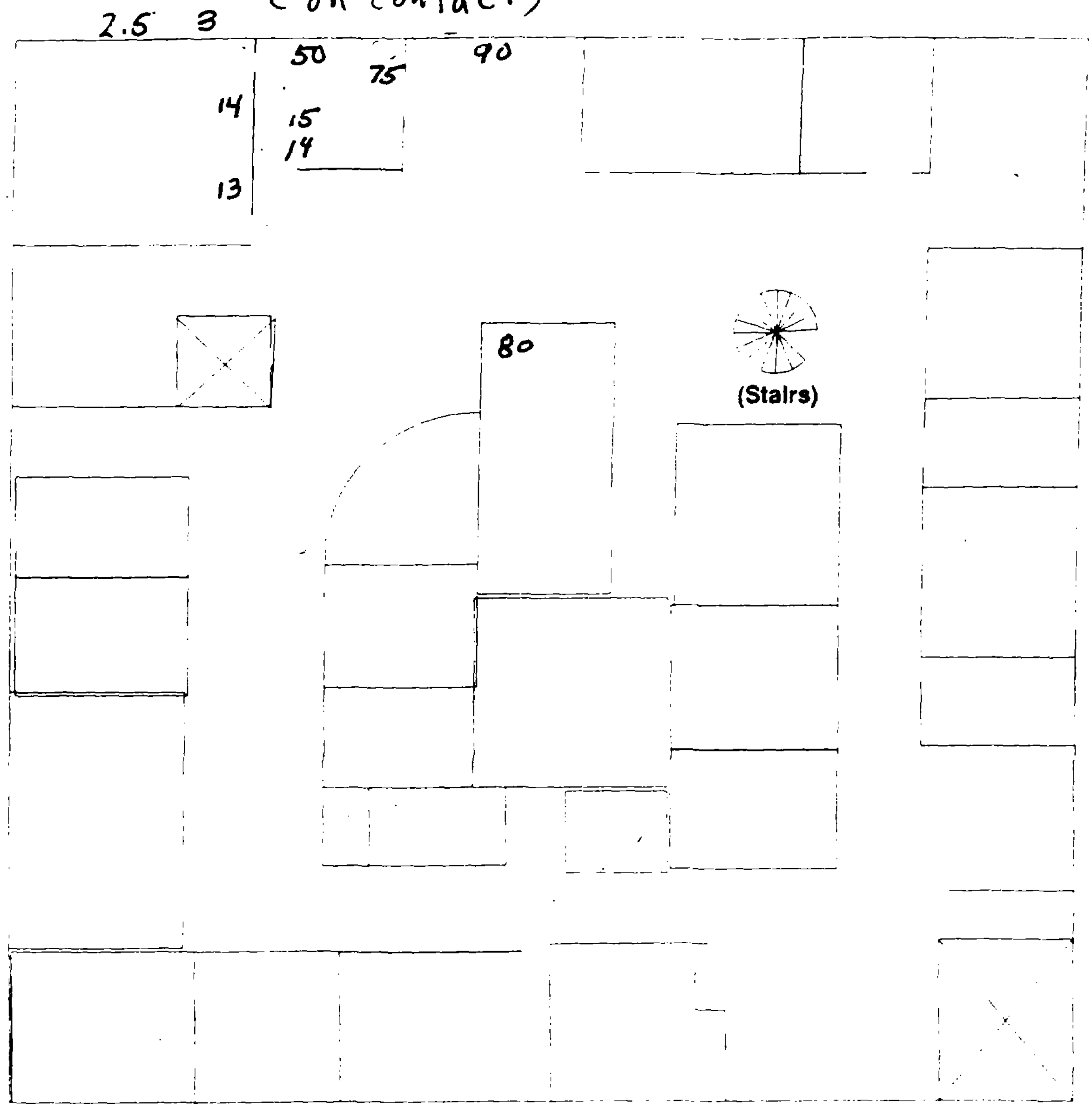
161 E. GRAND AVE., CHICAGO, IL 60611
PHONE: 312-321-0880 FAX: 312-321-9785

Appendix 4

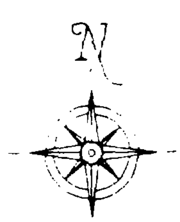
MICRO R METER MEASUREMENTS

Ludium micro-R meter (micro roentgen per hour, μR/hr) (on contact)

3/31/01 data



[redacted]



ecology and environment, inc.
Technical Assistance Team
Region V

TITLE 161 E. Grand Ave. 2nd Floor (Optumus)	FIGURE # Figure 2
SITE Lindsay Light Company	TDD# T05-9305-014
CITY Chicago STATE IL	SCALE Not to Scale
SOURCE Instrument: Ludium Model 19	DATE July 16, 1993
	REVISED

Appendix 5

RADON AND THORON MEASUREMENTS (GAS AND DECAY PRODUCTS)

Concentrations of radon-220 gas, radon-220 decay products, radon-222, and radon-222 decay products

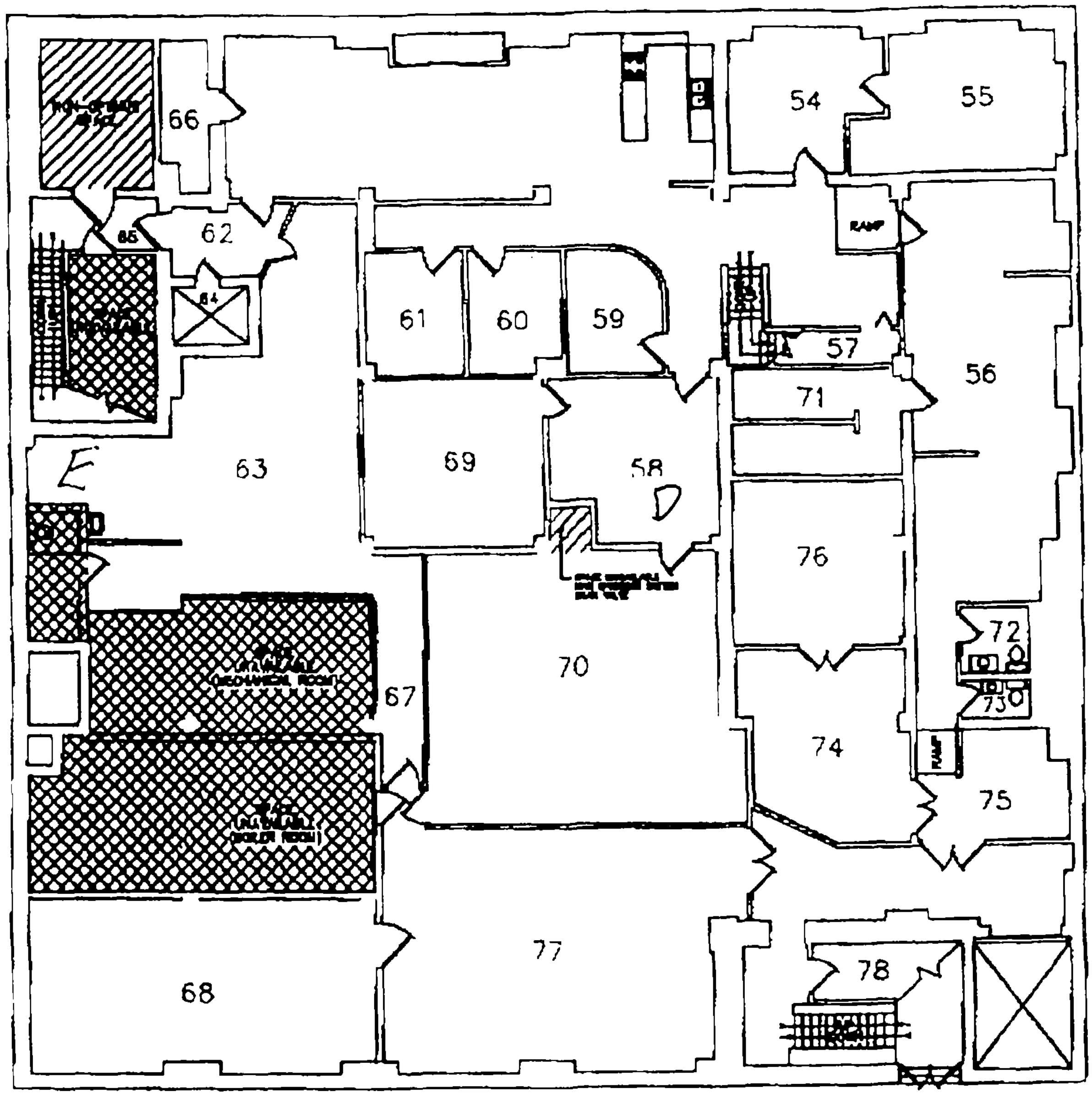
Data taken in the period 3/24/01 to 3/31/01

Area	Description	Radon-220 gas (pCi/L)	Radon-220 decay products (WL)	Radon-222 gas (pCi/L)	Radon-222 decay products (WL)	Radon/Thoron Rule of Ratios
E	Basement Chimney	89.5	0.361	0.0	0.000	18
D	Basement PC Workstation	2.0	0.008	0.9	0.004	0.6
F	1st Floor Reception	4.9	0.020	-0.7	-0.003	1.0
B	2nd Floor Room 35	#	#	#	#	#
A	2nd Floor Room 36	2.8	0.011	1.3	0.005	0.8
C	2nd Floor Room 37	0.6	0.002	0.3	0.001	0.2
I	3rd Floor Room 84	4.8	0.019	-1.1	-0.004	1.0
G	4th Floor Sound Mixing Room	2.0	0.008	0.5	0.002	0.5
H	5th Floor Ledge over couch	3.6	0.015	0.7	0.003	0.9

- data lost when electret accidently discharged

Negative concentrations treated as zero

A5-3



BASEMENT FLOOR PLAN

OPTIMUS
161 EAST GRAND AVENUE
CHICAGO, IL. 60611

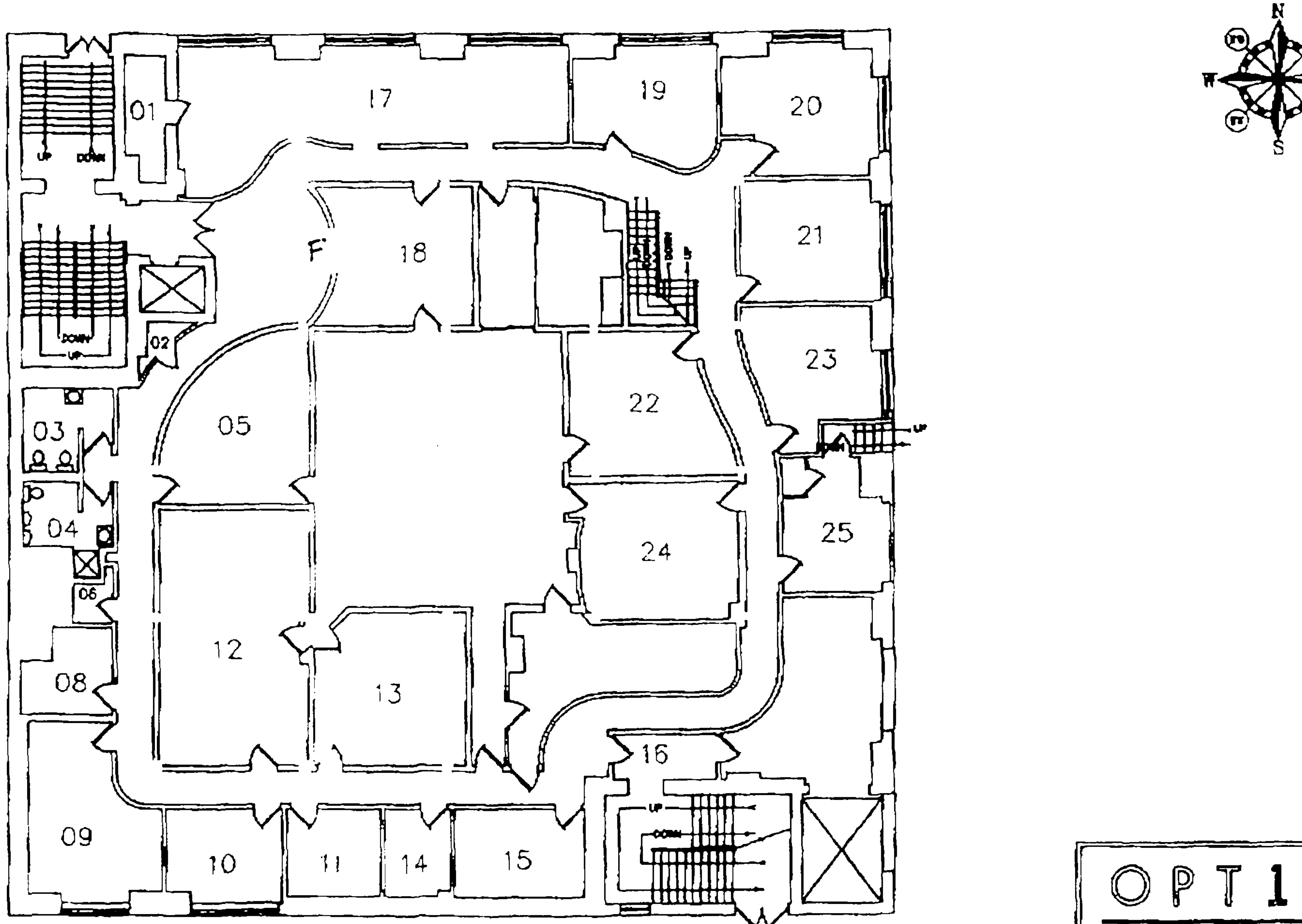
E-perms
Monitoring locations

OP

161 E. GRA
PHONE: 312-

DATE:	00/00/0
REV. DATE:	
CAD FILE NAME:	BAS
DRAWN BY:	M. BABIC
DESIGN. BY:	
APPROVED:	

A5-4



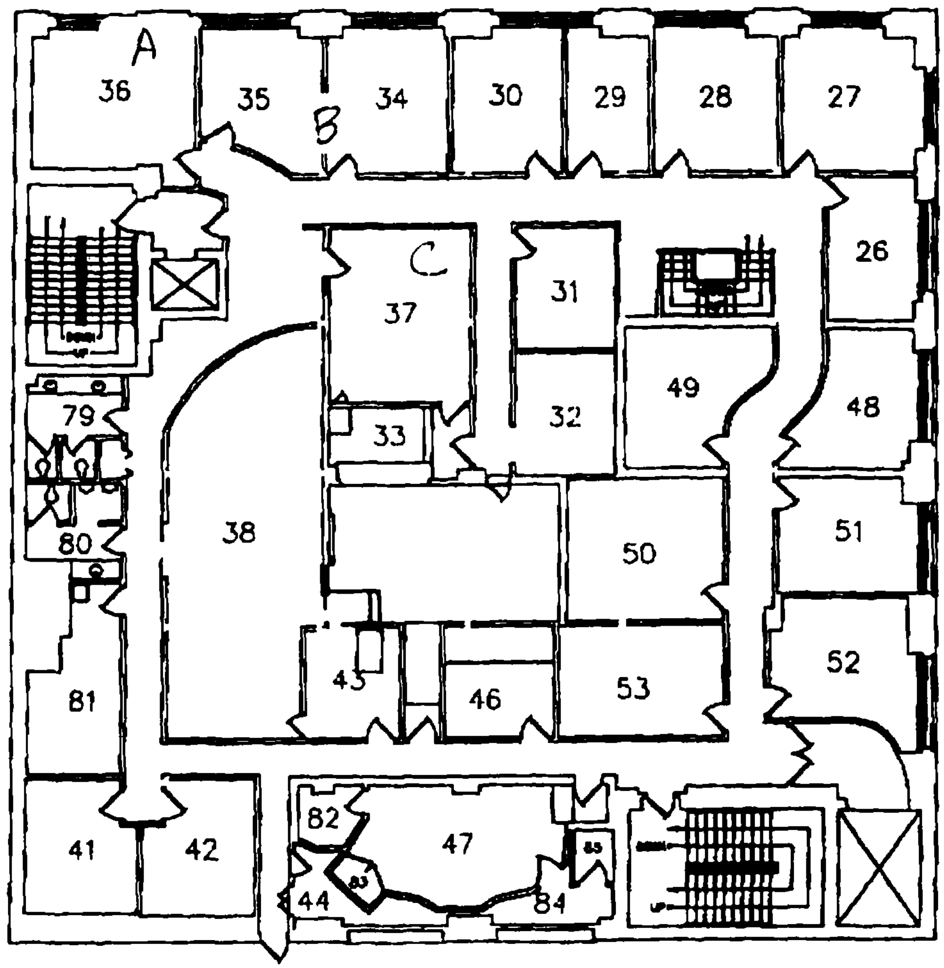
1st FLOOR PLAN

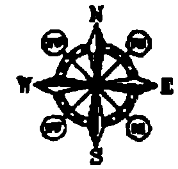
OPTIMUS
161 EAST GRAND AVENUE
CHICAGO, IL. 60611

E-perms
Monitoring locations

OPT1
161 E. GRAND AVE., CHI
PHONE: 312-321-0880 FA

DATE: 00/00/00	DESCR
REV. DATE:	
CAD FILE NAME: 1FLRPLN	
DRAWN BY: M. BABICH	
DESIGN. BY:	DRAWN
APPROVED:	SCALE





A5-5

2nd FLOOR PLAN

OPTIMUS
161 EAST GRAND AVENUE
CHICAGO, IL. 60611

E-perms
Monitoring locations

OPT1MUS

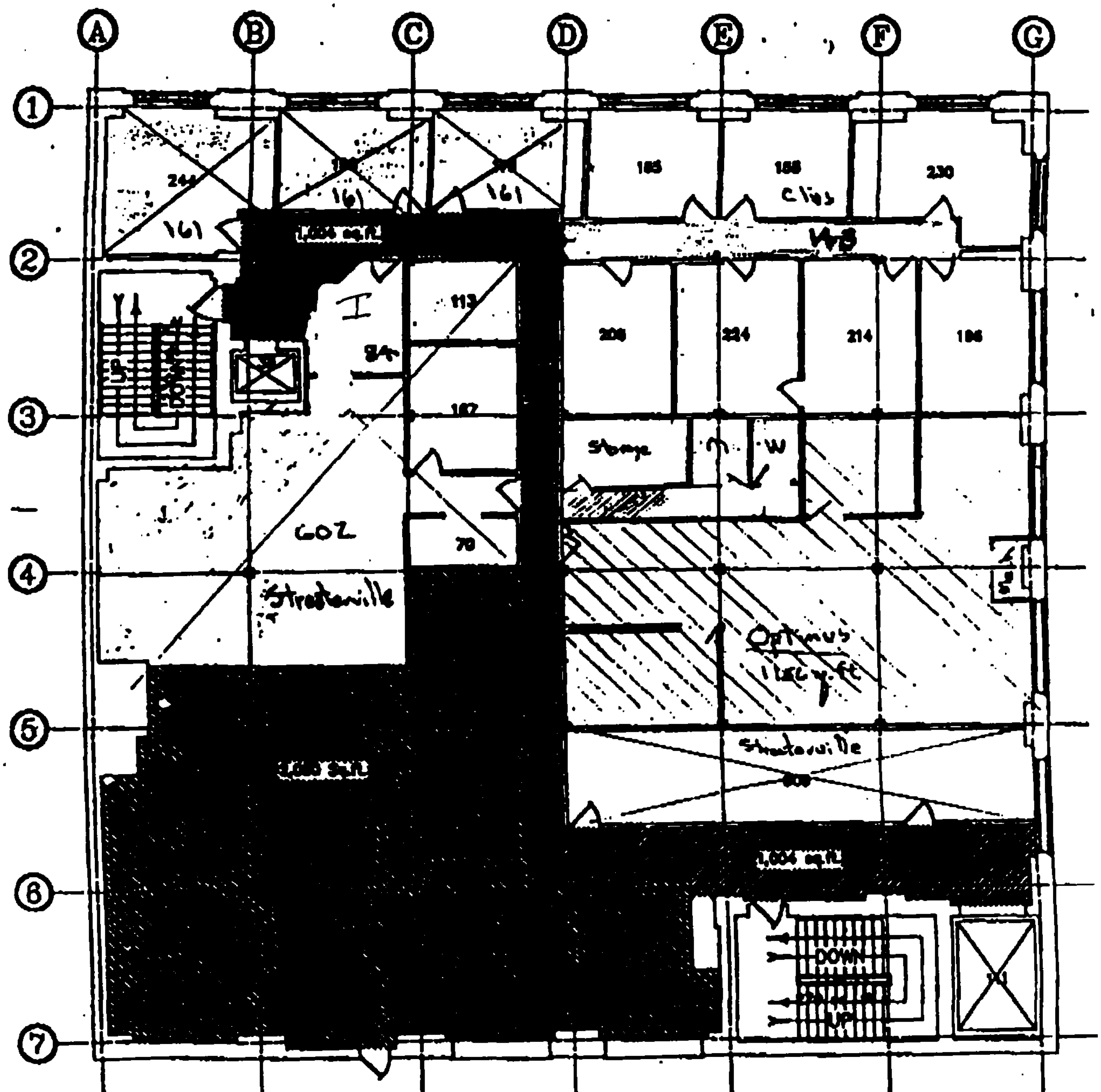
161 E. GRAND AVE., CHICAGO, IL 60611
PHONE: 312-321-0680 FAX: 312-321-9785

DATE: UNKNOWN

DESCRIPTION:

E-perms

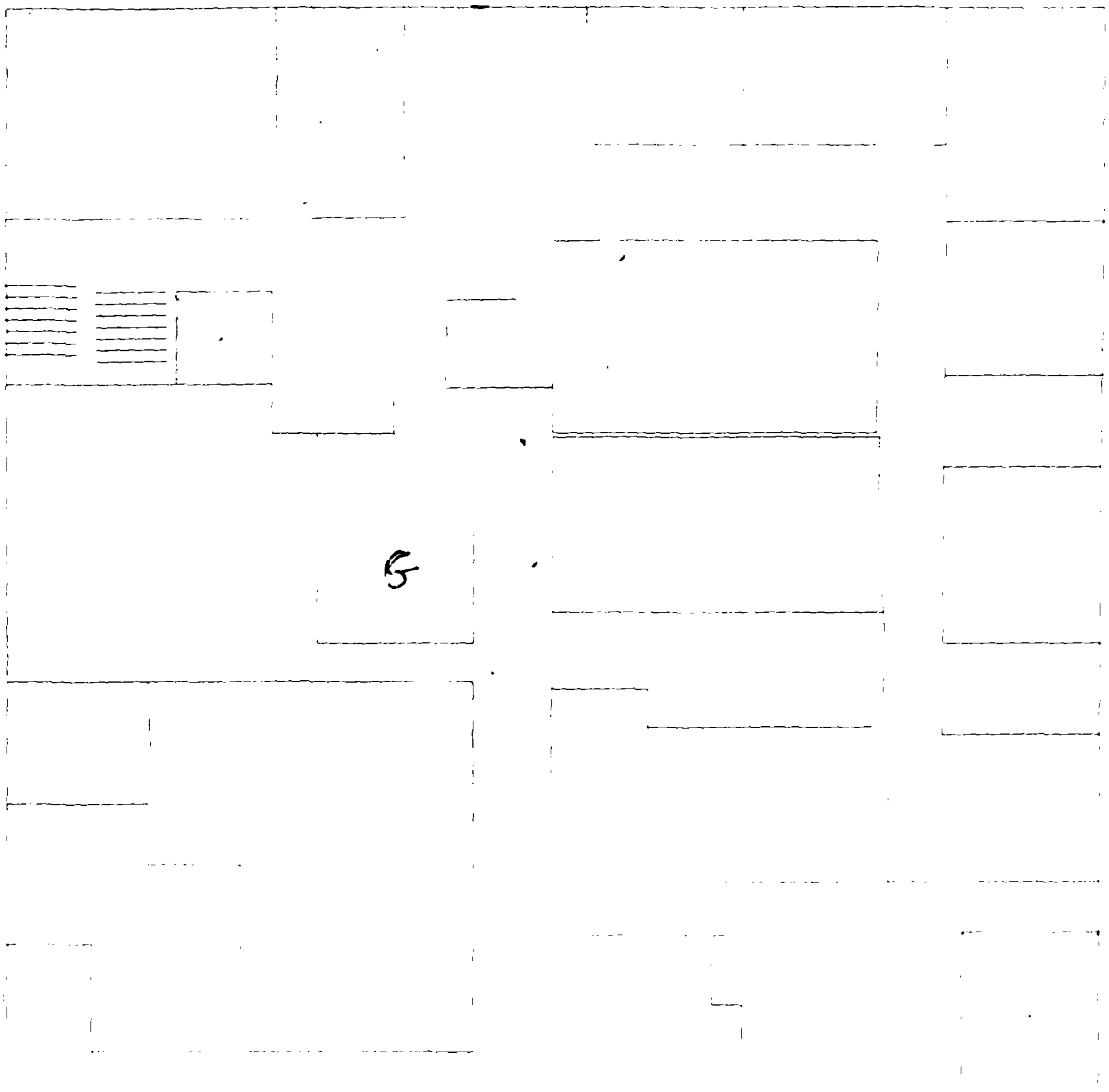
Monitoring locations



3rd Floor - 161 E. Grand Building

SCALE 1/16" = 1'-0"

E-perms
Monitoring locations



Floor Contact readings [illegible]

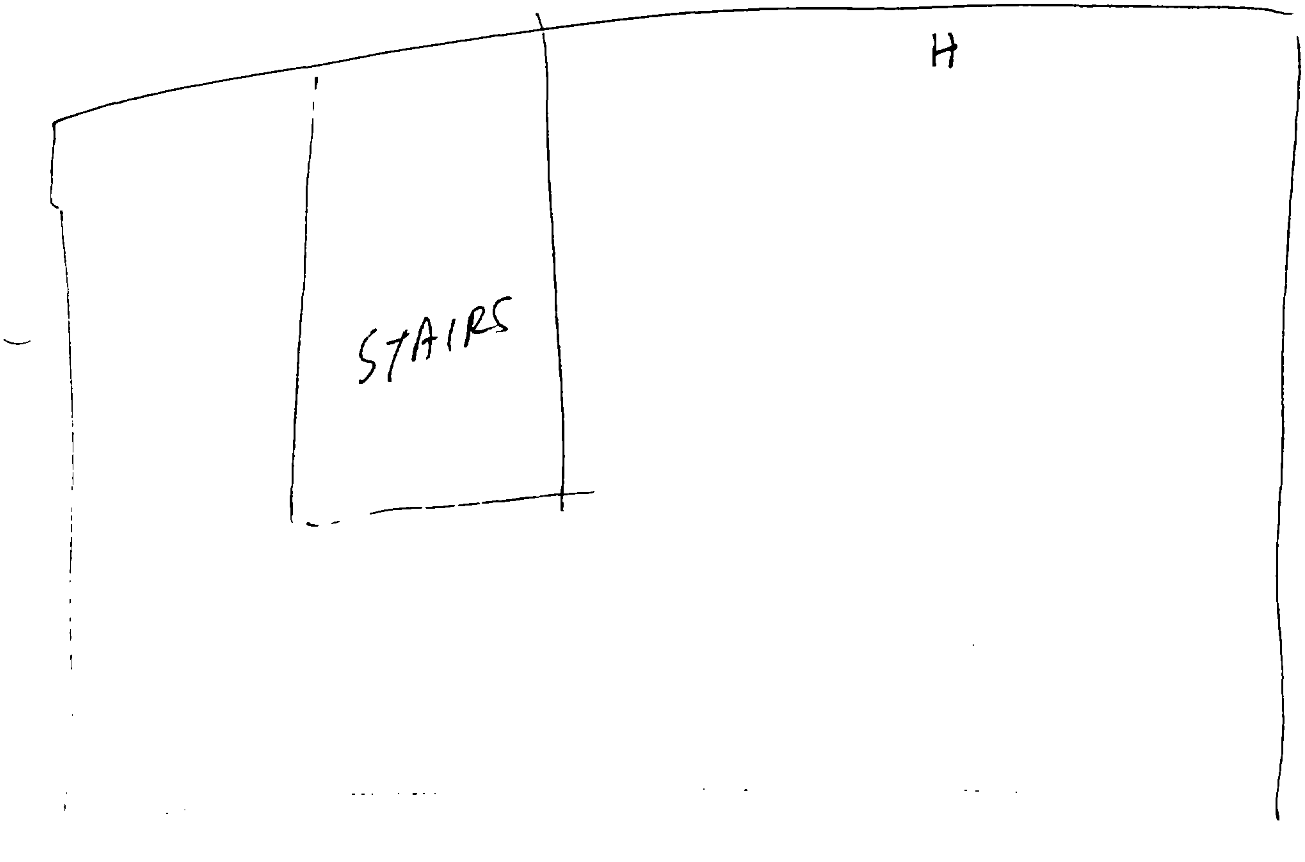
[redacted]

LEGEND

ecology and environment, inc.
Technical Assistance Team
Region V

TITLE 161 E. Grand Ave. 4th Floor (Streeterville)	FIGURE # Figure 4
SITE Lindsay Light Company	TDD# T05-9305-014
CITY Chicago STATE IL	SCALE Not to Scale
SOURCE Instrument: Ludium Model 19	DATE July 15, 1993 REVISED

E-perms
Monitoring locations



5TH Floor

Appendix 6

GROSS BETA, GROSS ALPHA SMEAR MEASUREMENTS

Smears from basement floor near chimney

Data collected on 3/27/01

	Gross beta (pCi)	Gross alpha (pCi)
At base of wall	37.8	75.9
2 feet from wall	41.1	61.6
4 feet from wall	26.0	53.7
6 feet from wall	21.5	33.8
8 feet from wall	22.2	39.9
10 feet from wall	16.6	36.9

Material from in and around chimney

Data collected on 3/27/01

Thorium Decay Series	At wall (pCi/g)	Duplicate At wall (pCi/g)	2 feet from wall (pCi/g)	4 feet from wall (pCi/g)	6 feet from wall (pCi/g)	8 feet from wall (pCi/g)	10 feet from wall (pCi/g)
Th-232							
Ra-228		14.3		10.3			
Ac-228							
Th-228							
Ra-224	16.4	18.2					
Rn-220							
Po-216							
Pb-212	16.4	15.7	14.0	9.8	8.23	6.98	5.43
Bi-212							
Po-212							
Tl-208	4.21	4.80	2.98	3.4	2.84	1.38	0.946

Uranium Decay Series	At wall (pCi/g)	Duplicate At wall (pCi/g)	2 feet from wall (pCi/g)	4 feet from wall (pCi/g)	6 feet from wall (pCi/g)	8 feet from wall (pCi/g)	10 feet from wall (pCi/g)
U-238							
Th-234							
Pa-234m							
U-234							
Th-230							
Ra-226							
Rn-222							
Po-218							
Pb-214							
Bi-214							
Po-214							
Pb-210							
Bi-210							
Po-210							

Other	At wall (pCi/g)	Duplicate At wall (pCi/g)	2 feet from wall (pCi/g)	4 feet from wall (pCi/g)	6 feet from wall (pCi/g)	8 feet from wall (pCi/g)	10 feet from wall (pCi/g)
K-40	11.4			9.4	15.7		

Appendix 7

IDENTITY, CONCENTRATION ON SMEARS

Material from in and around chimney

Sample collected on 3/27/01

Thorium Decay Series	Concentration (pCi/g)	Duplicate Concentration (pCi/g)	Average Concentration (pCi/g)
Th-232			
Ra-228	90.5	84.3	87.4
Ac-228			
Th-228	101	84.4	92.7
Ra-224	105	93.7	92.7
Rn-220	211	90.8	99.4
Po-216			
Pb-212	97.6	90.9	94.3
Bi-212	87.4	82.2	84.8
Po-212			
Tl-208	30.2	27.5	28.9

Uranium Decay Series	Concentration (pCi/g)	Duplicate Concentration (pCi/g)	Average Concentration (pCi/g)
U-238			
Th-234	11.0	7.87	9.44
Pa-234m		8.07	
U-234			
Th-230			
Ra-226			
Rn-222			
Po-218			
Pb-214	0.835	0.953	0.894
Bi-214			
Po-214			
Pb-210			
Bi-210			
Po-210			

Other	Concentration (pCi/g)	Duplicate Concentration (pCi/g)	Average Concentration (pCi/g)
K-40	18.0	17.6	17.8
Tl-201		1.80	

Appendix 8

REMOVABLE CONTAMINATION ON BOOTIES

Removable material on booties

Data collected on 3/27/01

			Gross Alpha (cpm)
Blank bootie			2.4
Fred Micke's booties			
	Bootie 1	**Side 1**	5.2
	Bootie 1	**Side 2**	5.0
	Bootie 1	**Side 1**	7.2
	Bootie 1	**Side 2**	4.6
Larry Jensen's booties			
	Bootie 2	**Side 1**	10.8
	Bootie 2	**Side 2**	4.0
	Bootie 2	**Side 1**	9.6
	Bootie 2	**Side 2**	3.8

Appendix 9

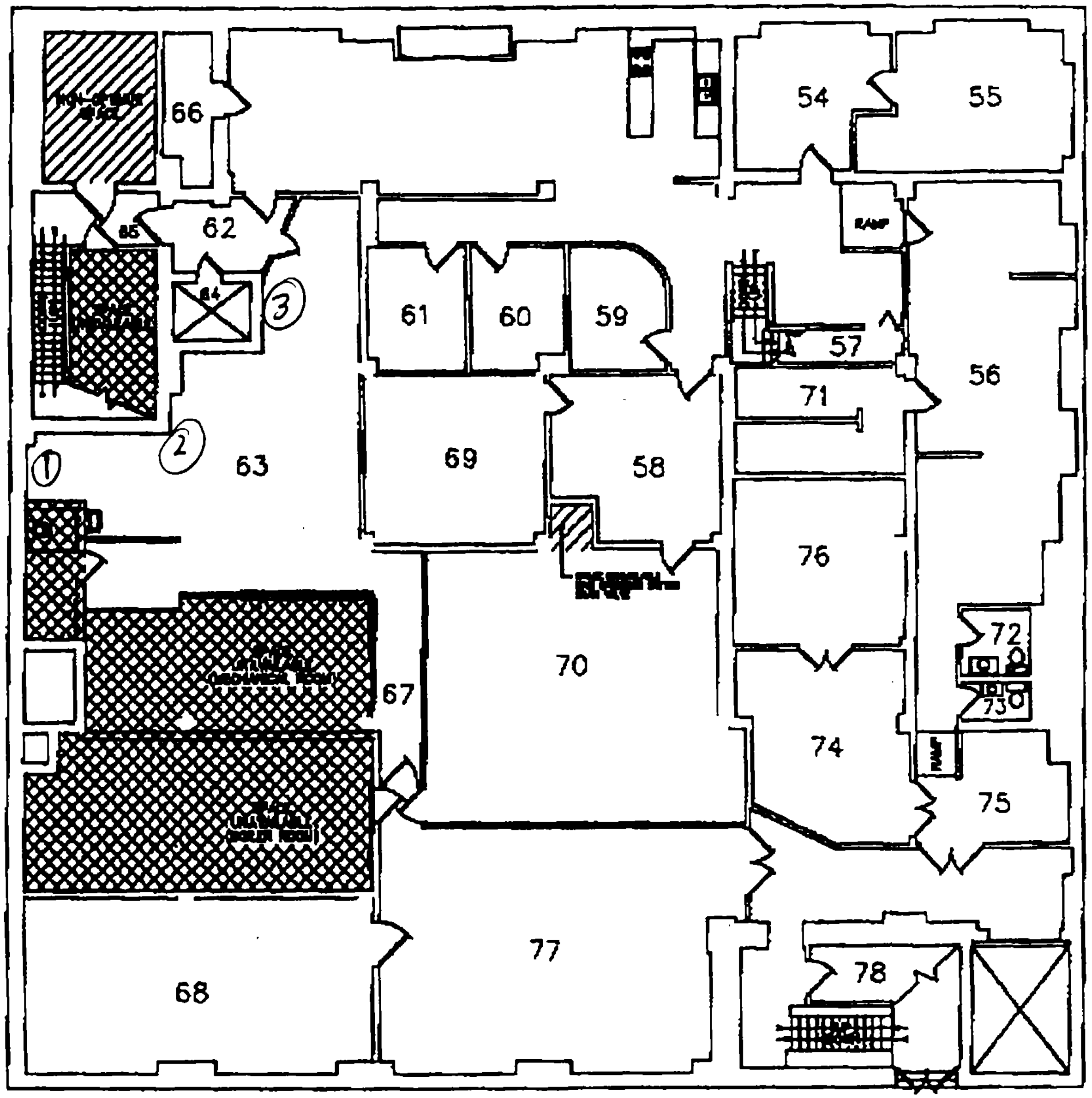
COUNT RATE NEAR CHIMNEY

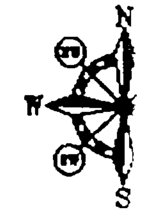
Contact Count Rates in Vicinity of Basement Chimney

Measurements made on 3/27/01

Location 1	**1 minute count**
Wall, Center of chimney	23228
Wall, 2 feet to left of chimney center	26012
Wall, 4 feet to left of chimney center	31997
Wall, 7 feet to left of chimney center	25964
Location 2	
Wall, 15 feet out from chimney (location 2)	15888
Location 3	
Wall around corner from chimney (location 3)	15475

A9-3





BASEMENT FLOOR PLAN

OPTIMUS
161 EAST GRAND AVENUE
CHICAGO, IL. 60611

Count rate
monitoring locations
(taken on 3/27/01)

OP
161 E. GRA
PHONE: 312-
DATE: 00/00/0
REV. DATE:
CAD FILE NAME: BA
DRAWN BY: M. BASIC
DESIGN. BY:
APPROVED: